REMARKS/ARGUMENTS

Claims 1-7 are pending in this application.

Claims 1 and 2 were objected to for a number of informalities. The changes suggested in the Office Action in this regard have been made.

Claim 3 was also objected to because the definite article should be used when the claim refers to a "single circuit board". Claim 1, line 8, recites "a circuit board", which means "one or more circuit boards". Claim 3 recites that the dimensional standards, etc. are arranged on a "single circuit board". Applicant submits the use of the indefinite article "a" in this instance is appropriate because in effect claim 1 does not recite a single circuit board, but one or more circuit boards. Claim 3 would be grammatically awkward at a minimum if the definite article "the" were used. Moreover, claim 3 would potentially be indefinite because if "the" were used, this might be construed as referring to the one or more circuit boards, which, of course, runs counter to what is being recited in claim 1.

In view of the foregoing, applicant submits that all claim objections set forth in the Office Action have been removed for purposes of clarification unrelated to patentability concerns.

Substantively, all claims were rejected for obviousness over Strasser (DE 100 60 574) in view of Okumura (6,246,232).

The Office Action acknowledges that Strasser does not disclose that:

- the axes of rotation of the first input shaft and the first transmission gears are not parallel to each other
- flanks of the teeth of these two gears are not parallel to the axis of the input rotation
- the number of teeth on the input gear is smaller than the number of teeth on the first transmission (driven) gear

- the pinion of the first transmission gear and the wheel of the second transmission gear have helical gears.

Okumura was considered to disclose what is missing from Strasser because crossed helical gears (3a and 7c) are used between the input shaft and the first transmission gear, and the number of teeth on the input gear is smaller than the number of teeth on the driven gear or rotator. From this, it was further concluded that the axis of rotation of the input gear and the first transmission gear are not parallel, the flanks of the teeth of the input gear and the first transmission gear are not parallel to the axis of input rotation, and the pinion of the first transmission gear and the wheel of the second transmission gear have helical gears. In view thereof, the claims were considered obvious to one of ordinary skill in the art because such person would replace the gearing of Strasser with that of Okumura.

Applicant disagrees.

Strasser, like the present application, discloses a multi-turn angle transducer capable of monitoring and tracking the angular position of a rotary member, such as a shaft, through multiple, often high-speed rotations. The rotation of the input shaft is reduced through gearing defined by multiple, conventional gears such as gears 21 and 22 (Fig. 1).

Okumura, on the other, discloses a rotation sensor for measuring the rotation angle and direction of a steering wheel. Unlike multi-turn angle transducers as disclosed in Strasser and in the present invention, Okumura's transducer only requires measuring limited rotation angles at very low speeds. Strasser provides no motivation to look at steering wheel angle transducers of the type disclosed by Okumura for building multi-turn transducers, which monitor members over many revolutions and at high speeds. Moreover, one of ordinary skill in the art would not be motivated to consult the automotive steering wheel art for input how to construct high-speed multi-turn angle transducers.

Strasser and Okumura are therefore not properly combinable for purposes of the present invention. For this reason alone, Strasser and Okumura do not suggest the present invention as defined by the claims.

One of ordinary skill in the art would further not combine Strasser and Okumura because they use fundamentally different approaches to sensing rotational angles.

Strasser discloses an angle transducer which, similar to the present invention, employs several coding disks or "dimensional standards" as recited in claim 1 of the present application. These coding disks are driven by the input shaft 2 of Strasser via gearing 20 consisting of multiple spur gear sets, such as gear wheels 21 and 22. In use, detectors or transducers 30, 31 and 32 (only 30 is shown in Fig. 1) detect the rotational position of the shaft, including the number of rotations and the relative angular position of the shaft at the time of measurement.

Okumura, on the other hand, has detection means 19 (Fig. 5), 15 and 21 (Fig. 3) for monitoring angular deflections or movements. The angular displacement of rotor 3 is transferred via helical gearing to a rotator 7 which rotates threaded shaft 6 (screw groove 6b) to linearly translate the detection means for measuring the angular displacement of rotor 3.

Okumura describes the purpose and function of this arrangement as follows:

> When the rotor 3 has made two turns (rotation in the direction of the arrow A in FIG. 3), the engagement between the screw groove 6b of the rotation shaft 6 and the thread 10b of the movable member 10 converts the rotation of the rotation shaft 6 to the linear motion of the movable member 10, the movable member 10 is moved in the axis direction of the rotation shaft 6 (direction of the arrow B in FIG. 3) with aid of guiding of the guide 10d along the guided member 2e to the position of the one end side of the screw groove 6b .... When the rotor has made left two turns (rotation in the opposite direction to the arrow A in FIG. 3), the movable member is moved to the position of the other end side of the screw groove 6b .... (column 12, lines 13-28; underlining added)

As this demonstrates, while Strasser discloses straight gearing for reducing the rate of rotation between the rotation of the input shaft and the rotation of the succeeding code disks or dimensional standards, so that the latter rotate at decreasing rates, Okumura uses a helical gear set to drive screw 6 and to thereby linearly reciprocate the detection means.

One of ordinary skill in the art faced with the problem of having to improve the multiple reduction gear driven code plates of Strasser would not consult a reference, such as Okumura, which discloses how to determine angular displacements of a shaft by converting the rotary motion of the shaft into a linear motion of the detectors, because the two have entirely unrelated mechanisms which operate completely differently, Strasser using straight reduction gears to reduce the rate of rotation of succeeding code plates, while Okumura converts rotary motion into linear motions.

Moreover, and contrary to the assertion in the office Action, while Strasser uses reduction gearings to reduce the rate of rotation of the code disks relative to the input shaft, Okumura does the opposite. Okumura necessarily increases the rate of rotation of driven rotator 7, and therewith of shaft 6, relative to the rate of rotation of driving rotor 3 (which is fixed to the steering wheel of the automobile), as is demonstrated by the much smaller diameter of the former relative to the latter. This is apparently necessary for Okumura to do in order to obtain the necessary revolutions to linearly move the detection means over the desired distances. In the present invention as defined by claim 1, the number of teeth on the driven (input) gear 40 is smaller than on the driving (input) gears 41 or 411.

For this additional reason, one of ordinary skill in the art would not combine Strasser with Okumura.

Still further, the rotation sensor of Okumura operates over only a few, e.g. two, rotations of rotor 3. (Column 12, lines 13-30). One of ordinary skill in the art would immediately notice that if Okumura were combined with Strasser, the large number of revolutions of Strasser's input shaft can result in the destruction of the detector of Okumura. If Okumura's detector is subjected to the many revolutions of Strasser (or of the present invention), screw shaft 6 would linearly drive the detectors into either gear 7 or the wall of the housing because Okumura's linear drive member 10 reaches the "end side of the screw" (column 12, lines 21 and 26) after only two revolutions of its rotor 3. If Okumura's rotor 3 were to turn through multiple revolutions, as is true for Strasser, the movable member 10 of Okumura would move past the end sides and crash into the rotor 7 or the housing.

For this additional reason, one of ordinary skill in the art would not combine Strasser with Okumura.

Further, neither Strasser nor Okumura contain any suggestion how and why the helical gearing between rotor 3 and rotator 7 of Okumura should be utilized by Strasser. Such motivation can only come from the present invention, which teaches the benefits of employing helical gears in a multi-code disk multi-turn angle transducer, which, as set forth in the specification, include:

> Benefits of the present invention are that even high rotational speeds can be measured, especially those of input shafts with large diameter, because of the high speed reduction at the first transmission stage, which enables a very compact construction for the multi-turn shaft encoder. Moreover, in such an arrangement the sensing units to detect the dimensional standards of the single and multi-turn stages can be arranged on a single circuit board. (specification, page 4, lines 6-11)

As is apparent from the specification quoted above, the present invention provides a "high speed reduction at the first transmission stage". Okumura achieves exactly the opposite at the transmission stage, namely a significant increase in the rotational speed in order to make the angle measurements.

Picking the helical drive used by Okumura from all other aspects of the rotation sensor disclosed therein, and combining it with Strasser, is a hindsight reconstruction of the prior art based on what is disclosed in the present application, and not what is taught by the prior art. However, even such a hindsight reconstruction does not suggest the present invention. Contrary to the present invention as defined by claim 1, the helical drive of Okumura increases and not decreases the rate of rotation at the first transmission stage. Thus, in order to make any use of Okumura when combining it with Strasser, the Okumura device would first have to be redesigned so that it reduces, but not increases, the rate of rotation at the first reduction gear.

For all of these reasons, one of ordinary skill in the art would not combine Strasser with Okumura, and if he did, the resulting angle transducer would be incapable of reducing the rate of rotation in the succeeding gearing stages.

Disregarding for the sake of argument that one of ordinary skill in the art would not combine Strasser and Okumura and, if it did, that he would not have an angle transducer capable of reducing the rate of rotation relative to the shaft the position of which is to be monitored, the combination of Strasser and Okumura still does not suggest the present invention.

Claim 1 requires that "a number of the teeth (Z_{40}) of the input gear (40) is smaller than a number of the teeth (Z_{41}) of the wheel (411) of the first transmission gear (41)". Okumura discloses the precise opposite—an input gear (rotor 3) which has a number of teeth that is much larger than the number of teeth on the first transmission gear (rotator 7)—as a comparison of their relative diameters in the drawings (Figs. 3-5) shows. Since Okumura's helical gear train (rotor 3, rotator 7) would necessarily have to be substituted for the first gear train of Strasser, the resulting combination does not suggest the foregoing quotation from claim 1.

For this further reason, claim 1 is not obvious over Strasser in view of Okumura.

Claim 1 also requires that "a pinion (412) of the first transmission gear (41) and the wheel of a second transmission gear (31) are configured as helical gears".

Strasser discloses the use of conventional spur gears only. Okumura has only one helical gear set, namely rotor 3 and rotator 7. Strasser and Okumura are both devoid of any disclosure concerning the placement of a helical gear set following the first gear set.

For this additional reason, claim 1 is not obvious over Strasser in view of Okumura, even if the two references were properly combinable, which they are not.

For all the foregoing reasons, claim 1 is not obvious over Strasser in view of Okumura.

Claims 2-7 are allowable in their own right because they are directed to specific features of the present invention which are independently patentable. They are further allowable because they depend from an allowable parent claim.

CONCLUSION

In view of the foregoing, applicant submits that this application is in condition for allowance, and a corresponding notification at an early date is requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at (415) 576-0200.

Respectfully submitted,

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